South Carolina

TECHNICAL ASSISTANCE GUIDE

SHEET NUMBER 1

Getting into the Large-Scale Composting Business

This technical information series is designed for South Carolina businesses and local governments who operate, or would like to operate, composting facilities. This publication is an overview of the composting process. A companion document addresses day-to-day issues and regulatory concerns. “Large-Scale Composting: Getting in the Business - Day-to-Day Operations” addresses daily issues and references some regulatory concerns.

Since 1993 when yard trimmings and land-clearing debris were banned from municipal solid waste (MSW) landfills in South Carolina, thousands of tons of organics have been diverted from disposal. But the potential for turning this material into diverse products that can be efficiently marketed has not been realized.

The goal of this series is to offer information to the state’s composting businesses to help achieve these goals.

New facility operators learn about large-scale composting during a recent training seminar.

What is Composting?

Composting is defined as "the aerobic decomposition of organic materials by microorganisms under controlled conditions."

During composting, microorganisms consume oxygen as they feed on the carbon and nitrogen contained in organic matter. As they digest organic matter's simple and complex sugars into their own bodies, they incorporate nitrogen and carbon into proteins and produce heat, carbon dioxide and water vapor as by-products. When the food supply--the carbon and nitrogen--runs out, the microorganisms become dormant, temperature falls and composting is complete. What's left is a fine-textured, dark, crumbly, odorless, rich material not unlike potting soil.

Currently, organics make up a large portion of materials going to landfills. This amounts to hundreds of thousands of tons of material that could be productively managed by composting.

SOURCE: “On-Farm Composting Handbook,” Ithica, NY: Natural Resources, Agriculture and Engineering Service, 1992 E-mail: NRAES@ cornell.edu)

Composting is not difficult.

While there are situations in which the process can "go wrong," remember that farmers have used an uncomplicated form of composting since ancient times. Just placing a mixture of animal manure and bedding in a stack typically will result in a low grade of compost in a year. A pile of tree leaves, unturned and ignored, will be reduced to compost in two to three years. When farms were smaller, it was fairly typical for farmers to use this passive form of composting. In today's world of closing landfills, population pressures, deteriorating soils and countless environmental issues, farmers and local government must take advantage of nature's bounty with more efficient composting systems.

Below are more sophisticated composting methods to achieve several objectives:

1. **Faster composting.** Compostable materials - manure, food scraps, etc. with a carbon source (dry leaves, wood chips) - piled in windrows and turned frequently will produce finished compost in three to four months. After proper curing (storage for one to two months), the finished compost is ready for sale or spreading. This faster throughput cuts the amount of space a facility must devote to composting activities.

2. **Better composting conditions.** Raw manure or food scraps by themselves will not compost properly. They are usually too wet and too compact to allow air movement through the pile and digest aerobically. When oxygen is too limited, anaerobic bacteria go to work. They produce gases with noxious odors. Manure stacks turn anaerobic under most conditions.

3. **Heat is beneficial.** Good aeration, accomplished mostly by proper material mix and pile size, provides ideal conditions for thermophilic (heat loving) bacteria to work. Not only does this increase the speed of composting, it generates temperatures high enough (in excess of 131 degrees Fahrenheit) to kill weed seeds and pathogens.

4. **More uniformity.** Frequent turning results in an end product that is granular and uniform, easy to spread with lime or fertilizer spreaders. Application is faster and doesn't require large, powerful tractors. There is less moisture to transport and less power is needed than it takes to beat, propel or inject manure.

5. **Simplicity and ease of operation.** Investments in concrete or asphalt pads eliminate the mud and ruts that can result when weather turns ugly at the composting site. Grading the site and providing a two percent slope should divert rainwater to an infiltration area or retention pond. Some facilities go so far as to build roof-covered pads. Commercial turners take less time and do a better mixing job than front-end loaders. One recommended management practice is the use of geo-synthetic fiber "fleece blankets" to prevent rain from saturating composting windrows. And, after the active phase of composting, the piles should be covered to prevent reintroduction of pathogens.

The Benefits of Composting

- Composting reduces the amount of solid waste managed through disposal and extends the life of landfills.
- Composting lowers the potential for environmental hazards (air emissions and groundwater contamination).
- By reducing waste, composting helps state's reach their waste reduction and recycling goals.
- Compost facilities create potential profit for the communities through sale of landscaping material (mulch and compost).
- Compost improves the water-holding capacity of soil and increases soil aeration allowing better root structure.
- Compost allows plants to absorb nutrients more effectively.
- Compost conditions the soil; it then requires less water.
- Compost has been found to reduce soil-borne plant diseases without the use of chemical control.

6. **Ingredient flexibility.** While some compost makers are able to control manure composition by bedding barns with straw, leaves, sawdust, wood chips or even shredded newspapers, most manure comes from the barn needing ingredient manipulation at the composting site. There, composters can be flexible and add whatever is readily available--leaves from urban yards, waste hay from barn lots, spoiled hay or silage, sawdust or wood chips, crop residues, food processing wastes and others. Shredded yard trimmings and land clearing material are the most common high carbon sources used to mix with manure and other high nitrogen feedstocks.

7. **Desire for quality.** Not all compost is equal in quality. The type of feedstock, the composting process and curing time all affect the quality of the final product. High dollar market - including topsoil blenders, landscapers, retail-garden centers, sports turf and nurseries - require a very stable consistent product, high in organic matter. High volume markets - including landfill cover, mine reclamation, state transportation agencies, agriculture and silviculture - may accept compost that is less stable and particle size is not as important. All markets, however, require a compost which has undergone thermophilic biostabilization.

Managing the Composting Process

Most composters manage composting as a continuous flow process. At a farm site, manure is removed from the barns - sometimes to temporary storage - and then to windrows that are built of manure combined with carbon-source materials.

The space required depends upon how many windrows will accumulate. Some will be in the process of being built, others in various stages of completion, and some will be waiting to be spread on fields. Generally, the space required is dictated by the amount of manure produced in two to four months - the length of the composting process - plus space for storage until the compost is cured and then spread or moved off the farm. Windrows are usually 10 to 15 feet wide and five feet high.

Because the release of heat is directly related to microbial activity, temperature is a good indicator of how the composting process is going. A good thermometer is a good investment. In a windrow containing the right ingredients, temperature should rise quickly to 120 to 140 degrees Fahrenheit as readily degradable compounds are consumed. As composting slows, temperature will fall to around 100 degrees and then, gradually, to ambient air temperature.

The heating process is self-limiting. When temperatures reach about 160 degrees, even thermophilic bacteria are killed, so turn the material and release heat before it gets that hot.

As composting progresses, the heat generated will rise and oxygen will be drawn into the windrow.

The Georgetown County Composting Facility covers windrows with large tarps made from a special fabric to ensure proper moisture levels.

The temperature will fall when oxygen levels are depleted by the microbes as the feedstocks and bulking material decompose. Turning helps regulate the composting process and helps create the final homogenized texture of the finished compost.

In a sense, the composting process does not end until all the digestible carbon is converted to carbon dioxide gas or humus by the microbes. But before that happens, microbe activity slows and the compost becomes relatively stable.

According to the “On-Farm Composting Handbook,” "Microorganisms decompose organic materials progressively, breaking them down from

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complex to intermediate to simple compounds. The nutrients that become available during decomposition remain in the compost within the bodies of new microorganisms and as humus. The final product has a low rate of microbial activity but it is rich in microorganisms and the remains of microorganisms."

Composting proceeds best when the carbon to nitrogen ratio of the material is 25 or 30 to 1, but 20 to 40 to 1 is a workable range. The best moisture content is 50 to 60 percent, but 40 to 65 will work. The best pH is near neutral, but 5.5 to 9 will work. Bulk density (weight per unit volume of mixed material) should be less than 40 pounds per cubic foot.

Because composting is a flexible process, as the ranges above indicate, the recipe is flexible, too. When manure is too wet or too large a part of the mixture, nitrogen losses, such as ammonia or other gasses, will be larger. High-carbon sources like straw or sawdust capture nitrogen as it is released and slow the decomposition process.

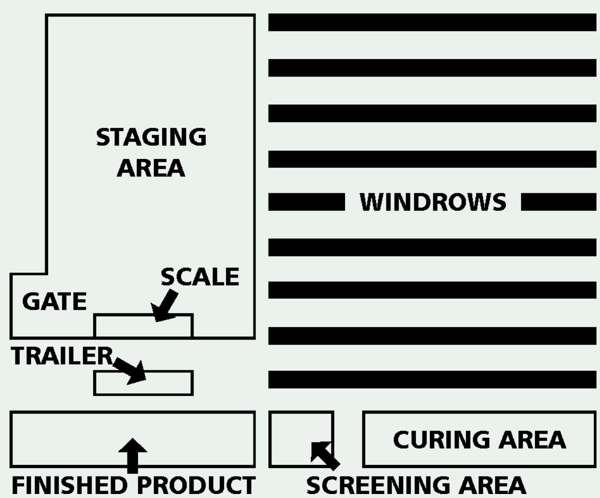
Successful composters will maintain conditions to control the process to produce a consistent product to sell or use at their facility. Control means testing or checking a standardized table for each feedstock for moisture, carbon and nitrogen levels and then calculating the amounts of each that are needed. In general, two parts of raw manure mixed about one part of relatively dry straw or sawdust by volume will produce a compostable mixture of about the right carbon to nitrogen ratio and moisture level. To keep the moisture level right, windrows are usually covered with special fleece blankets or tarps that shed water but allow gas and heat to flow in and out.

This techinical information sheet was adapted from the Michigan State University Extension Service publication, "Getting Started in Composting," with permission.

The Compost Site

An important part of any composting operation is the location of the site and the construction of the pad. The site should allow for year-round access if it will be used all months of the year. There are several guidelines that should be followed to provide environmental protections:

1. The compost site should have a two percent down slope and no cross slope.
2. Size the pad according to the volume of material to be handled.
3. Locate it away from surface water and away from wells that might lead to groundwater contamination.
4. Place the site close to where the materials are generated or initially received.
5. Set back the site from residential dwellings and preferably downwind.
6. Develop a filter strip or retention pond to handle the water runoff from the site.
7. Be aware of and satisfy local zoning issues.



The diagram above shows the major components of a typical large-scale composting facility.

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